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Review Article

Food Fortification: A Strategy to Reduce Micronutrient Deficiencies

Juan Ernesto Bárcena*

Regulatory Affairs Manager, Human Nutrition and Health, DSM Nutritional Products, Mexico

***Corresponding Author:** Juan Ernesto Bárcena, Regulatory Affairs Manager, Human Nutrition and Health, DSM Nutritional Products, Mexico.

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Abstract

In the last decades, concerns surrounding micronutrient deficiencies in the population have grown as a result of the impact on health, in addition to this problem affecting a large percentage of the world population. According to FAO data from the Second International Conference on Nutrition, which took place in 2014 and was organized by the World Health Organization, more than 2 billion people are deficient in micronutrients, primarily vitamin A, iodine, iron, folic acid and zinc. The epidemiological and nutritional transition taking place in the Latin American countries imposes an additional challenge on public policies. Mexico is a clear example of the high prevalence of micronutrient deficiencies. Nutritional interventions are one of the measures with the greatest social and economic impact in the history of public health. The active and focused participation in the public's well-being across all sectors - academia-government-industry - is indispensable.

Keywords: *Food Fortification; Micronutrient Deficiencies*

Introduction

The epidemiological and nutritional transition taking place in the Latin American countries imposes an additional challenge on public policies regarding food safety and nutrition. On one hand, to continue focusing on eradicating malnutrition and on the other, to deal with the growing and worrying prevalence of an overweight and obese population.

The World Health Organization (WHO) expressed concerns regarding the challenge of reducing this nutritional transition, also known as the double burden of malnutrition, with the following written statement: "We are aware that malnutrition - in all its forms, including undernutrition, inadequate micronutrients, overweight, obesity - affects not only a person's health and well-being, negatively impacting their physical and cognitive development, weakening their immune system, increasing the susceptibility to communicable and noncommunicable disease, limiting overall human potential and reducing productivity, but also inflicts a number of negative social and economic consequences on individuals, their families, for communities and for countries" [1].

In the last decades, concerns surrounding micronutrient deficiencies in the population have grown as a result of the impact on health, in addition to this problem affecting a large percentage of the world population. According to FAO data from the Second International Conference on Nutrition, which took place in 2014 and was organized by the World Health Organization, more than 2 billion people are deficient in micronutrients, primarily vitamin A, iodine, iron, folic acid and zinc [1].

The most vulnerable groups are children under 6 years and pregnant or breastfeeding women, given the greater nutritional demands at these biological stages. Even when the deficiencies are minimal, the individual's potential for maximum development is affected. Children that are given adequate nutrition in the first 1000 days of life will be less likely to die prematurely, will have a greater chance of remaining in school and studying and will have a greater chance of earning higher salaries later in life in addition to being more likely to have healthy children themselves. Among adults, the most common consequences of deficiencies are lethargy, a fall in physical and reproductive capacity, deterioration in the cognitive function and a weaker immune system [1,2].

It is therefore necessary to establish the magnitude of deficiency of each micronutrient in order to establish adequate public policies and interventions according to the different populations, not forgetting that the intersectoral actions (government-academia-industry) will always be fundamental given the abilities of each to reduce the margins of micronutrient deficiencies.

Micronutrient deficiencies in Mexico

Regarding Mexico, an analysis of national surveys (2006 and 2012) enabled us to identify the nutritional state of the population in terms of certain micronutrients. For vitamin A, Cediel and collaborators published research results including national representative samples (ENSANUT, 2006) that showed a high percentage of risk of deficiency in children: 5 - 6 years (35.8%), 7 - 8 years (31.9%) and 9 - 11 year (58.6%) [3].

Results from ENSANUT 2012 for vitamin B12 highlight a low deficiency in preschool-age (1.9%) and school- age (2.6%) children [4], however, in the case of women of a fertile age (20 - 49 years) the percentage rises to 8.5% [5].

The prevalence of anemia in 2012, according to ENSANUT results, indicates that priority should be given to pregnant women, given that an average of 1 in every 6 women suffered from the condition [6]. This is of major relevance, considering the harmful effects on the health of the baby associated to iron deficiency in pregnant women and could be related to a greater risk of maternal and infant mortality given the severity of the condition. According to ENSANUT 2012, the national prevalence of anemia in preschool-age children was 23.3% - 2,084.738 children - with 10.1% in children from 5 to 11 years and 5.6% in children from 12 to 19 years. Despite the fall in anemia in children from 1 to 4 years in the last 13 years (8.3 pp), it remains a concern. A higher prevalence of anemia was found in children from 12 to 23 months (38%) when compared to older groups, such as 4-year-old children (13.71%) [7].

In recent years, another similar concern has arisen: vitamin D deficiency. The reason for this is the high prevalence of vitamin D deficiency in children (1 - 11 years) and women of fertile age (20 - 49 years). ENSANUT 2012 survey results show that 25.9% of preschool-age children are deficient in Vitamin D, and 36.6% of school-age children [8]. In women, the situation is equally as worrying with 36.8% of women with vitamin D deficiency and 49.8% [9] with insufficient amounts of vitamin D. The average consumption of vitamin D was 2.56 µg/d [9] while the recommended amount, according to the Institute of Medicine (United Sates), is around 15 µg/d. This problem has been cited in recent publications giving that vitamin D is not only important for absorbing calcium and for bone health, it also affects muscle strength, as a regulatory agent of the metabolism of glucose and fat, strengthens the immune system, improves cardiovascular function and neurological development, among others.

Regarding vitamin E, despite having no national data, two studies carried out in Mexico indicated that vitamin E deficiency can be classified as a serious public health problem in children and women of fertile age. The study showed that 70% (1.5 - 3 years) presented deficiencies in vitamin E (α-tocopherol < 400 mg/dL). The other research which included women aged between 12 and 49 years showed a 46% prevalence in vitamin E deficiency (α-tocopherol/cholesterol < 2.25 mg/dL) [10].

According to results presented by Shamah-Levy and collaborators on the nutritional state of some micronutrients in Mexican children in 2006, zinc deficiency was high across all age groups (27.5% in children under 5 years and 23.6% in children between 5 and 11 years) and fell 5.6 pp in children under 5 years between 1999 and 2006. There was a high prevalence of low concentrations of magnesium and copper. Regarding magnesium, children from 1 to 11 years presented a 22.6% deficiency while 37% of adolescents (12 - 19 years) presented deficiency. In terms of copper, the figures presented were 30.6% in children (1 to 11 years) and 14.1% in adolescents [11].

The prevalence of folate deficiency in children under 5 years (3.2%) is marginal and not considered a public health problem, according to WHO criteria. This however does not mean that use of folate supplements or fortification during pregnancy to reduce the risk of neural tube defects must be suspended [11].

The reduction in incidence of neural tube defects due to folic acid deficiency is a clear example of how intersectoral work between: A) the academic area - that has always taken the role of developing science that is converted into health benefits for the population - which identified a health problem (NTD) associated primarily to folate deficiency. B) the government, that understands and implements large-scale public health programs and/or policies, as was the case with the obligatory fortification of flours and C) the industry, with its developments and technological capabilities to execute this policy via channels of distribution, monitoring, control of its processes and addition of this and other micronutrients without passing on organoleptic changes to the final consumer. This enabled this public health measure to work not only in Mexico but in the whole Latin America, saving the lives of thousands of children and preventing serious paralyses as a result of NTDs.

The role of industry in public health

Another example of how the industry has been and will continue to be an important contributor to public health is the industrial production of nutrients, enabling large-scale intervention, as is the case of the fortification of salt and consequent elimination of goiter and cretinism (since 1923), flour fortification in the first half of the 20th century and the elimination of pellagra and beriberi, sugar fortification in Central America and the elimination of vitamin A deficiency and the resulting blindness. All of these actors (government, academia and industry) can play a role in the fight for better health.

Interventions in nutrition are one of the measures that have had the greatest social and economic impact in the history of public health. The focus on the public well-being of all of the previously mentioned sectors is what enables continual effectiveness and sustainability over time.

Food fortification contributed and continues to contribute to meeting and maintaining millennium development goals. With an improvement in the nutritional state of individuals comes an increase in productivity, contributing to a reduction in poverty. Micronutrients (such as iodine, vitamin A, iron, folic acid) improve cognitive functions, intellectual capacity and overall health, leading to a reduction in school absences and drop-out rates, in addition to maternal and infant morbidity and mortality rates [12].

As previously mentioned, the world is facing a coexistent dilemma regarding nutritional deficiency, overweight and obesity. With changing lifestyles, an aging population and major pressure on the food industry and the population in general to lower the consumption of high energy foods, comes the challenge of how to reach this objective without decreasing the ingestion of essential micronutrients and the opportunity to develop products and services that enable consumers to choose appealing and accessible diets.

In turn, we are increasingly hearing the term “nutrient density” at nutrition forums. This concept illustrates the quantity of nutrients per kilocalorie. In other words, a nutritionally dense food will present a large quantity of nutrients with a low quantity of energy. In general, however, the most highly nutritious foods are more expensive. Therefore, it is extremely important to increase the nutritional density of the foods that the least privileged population can afford, thus, meeting the goal of producing nutritious, accessible, acceptable, and appealing foods [13].

The industry must therefore respond to this new challenge, as done in the past, by enriching basic foods and as a result eliminating a range of problems resulting from malnutrition such as goiter, cretinism and blindness. In the current context, we perceive that sustainable and, consequently, socially responsible behavior, is not a politically correct or humanitarian attitude, but simply good business practice. It is necessary to recognize that in an under nourished and/or underproductive society it is not possible to develop business. Therefore, the industry understands that products with nutritional value must be a part of the sustainability policy of a company, and not only as a strategy to promote its products [14].

Conclusion

It is a fact that global population faces the double burden of malnutrition, a condition that promotes the incidence of chronic diseases, decreases productivity and generates poverty. Therefore, the private sector must act in a sustainable way to reverse the negative scenario, working together with the academy and governments. As it was done in the past, the enrichment of basic foods, such as salt, wheat flour and sugar with micronutrients is proven to be an effective strategy to eliminate a range of problems, including goiter, cretinism and blindness. By increasing the nutrient density of food it is also possible to confront overweight and obesity. Besides, in the current context, we perceived that socially responsible behaviors are not simply politically correct or humanitarian attitudes, but essentially good business practices. It is necessary to recognize that it is not possible to develop business in an undernourished and/or underproductive society. Thus, the industry must realize that products with significative nutritional value must be a part of the sustainability policy of a company and not a mere strategy to promote its products to the market.

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